AD ______________

COOPERATIVE AGREEMENT NUMBER DAMD17-95-2-5022

TITLE: Operating Environment of the Future

PRINCIPAL INVESTIGATOR: Matthew E. Hanson

CONTRACTING ORGANIZATION: Northrop Corporation
Pico Rivera, California 90660-3783

REPORT DATE: January 1997

TYPE OF REPORT: Final

PREPARED FOR: Commander
U.S. Army Medical Research and Materiel Command
Fort Detrick, Frederick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	January 1997	Final (22 Sep 95 - 20 Dec 96)

4. TITLE AND SUBTITLE
Operating Environment of the Future

5. FUNDING NUMBERS
DAMD17-95-2-5022

6. AUTHOR(S)
Matthew E. Hanson

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Northrop Corporation
Pico Rivera, California 90660-3783

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Commander
U.S. Army Medical Research and Materiel Command
Fort Detrick, Frederick, Maryland 21702-5012

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200*

The report documents the progress achieved on the "Operating Environment of the Future" (OEF) project from initial award in October 1995 through December 1996. The purpose of the project is to develop the next-generation, multi-platform tri-service integrated medical environment. The scope of the project encompassed three systems: the Intuitive Display and Command System (IDACS), the Smart Surgical System (SSS), and the Intelligent Virtual Patient Environment (IVPE). The project is one of several targeting reduction in mortality and morbidity of the wounded soldier through improved far-forward combat casualty care. The objective of this initial phase was to develop a breadboard IDACS. The approach involved integrating off-the-shelf hardware, mockups, and existing software. Results included the demonstration of a real-time, wireless video transmission of clinical imagery and data; a brassboard mockup of a body-worn Surgeon Interface Unit, including stereo visor, audio, speaker-independent voice recognition, and wireless transceiver; software filtering of an acoustically-sensed heart rate.

14. SUBJECT TERMS
medical, displays, combat casualty care

15. NUMBER OF PAGES
8

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

FOREWORD

Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the U.S. Army.

____ Where copyrighted material is quoted, permission has been obtained to use such material.

____ Where material from documents designated for limited distribution is quoted, permission has been obtained to use the material.

CMD Citations of commercial organizations and trade names in this report do not constitute an official Department of Army endorsement or approval of the products or services of these organizations.

____ In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and use of Laboratory Animals of the Institute of Laboratory Resources, National Research Council (NIH Publication No. 86-23, Revised 1985).

____ For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

____ In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

____ In the conduct of research utilizing recombinant DNA, the investigator(s) adhered to the NIH Guidelines for Research Involving Recombinant DNA Molecules.

____ In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories.

PI - Signature 3/27/97 Date

TABLE OF CONTENTS

INTRODUCTION

Subject

This report documents the progress achieved on the "Operating Environment of the Future" (OEF) project sponsored by the Defense Advanced Research Projects Agency (DARPA) from initial project award in October 1995 through concept demonstration in December 1996. This report updates the interim report submitted in October 1996 by reflecting the results of the December 1996 concept demonstration.

Purpose

The purpose of the OEF project is to develop the next-generation, multi-platform, tri-service military integrated medical environment.

Scope

The scope of the project encompassed three principle systems within the OEF: 1) the Intuitive Display and Command System (IDACS) providing real-time information management through integrated displays, hands-free interface, local / remote connectivity, and a wireless, multi-media environment; 2) the Smart Surgical System (SSS) integrating physiological sensors with the surgical platform, incorporating advanced materials, and optimizing ease-of-use, mobility, and deployability; and 3) the Intelligent Virtual Patient Environment (IVPE) employing modified actual surgical instruments and a simulated patient for the improvement of surgical skills, training in battlefield procedures, and automation of performance measurement.

Background

The OEF project is one of several advanced medical technology programs initiated by the Defense Advanced Research Projects Agency (DARPA), targeting reduction in mortality and morbidity of the wounded soldier through improved far-forward combat casualty care. Emphasis in this initial phase was placed on developing a "breadboard" IDACS, with correspondingly less effort on the SSS and IVPE elements.

OBJECTIVE

The objective of the initial phase of the OEF project, documented in this report, was to develop a "breadboard" Intuitive Display and Command System (IDACS) to demonstrate the effectiveness of an integrated, wireless, hands-free command-and-control station for the Operating Room.

APPROACH

The approach employed in developing the IDACS was to modify and integrate off-the-shelf hardware, mock-ups, and existing software to provide basic hands-free control and display, making use of mature software modules, software development processes, and systems integration practices.

RESULTS and DISCUSSION

The results of this initial phase were demonstrated to DARPA in December 1996, and included:

1. Developing, using modified commercial components, a wireless link for transmitting real-time video and overlaying graphics and imagery. During the demonstration, a real-time video image of the Smart Surgical System surgical table and a separately generated graphical images of a patient heart rate trace were combined by IDACS and wirelessly transmitted for display on a large screen monitor.

2. Developing, using modified commercial components, a wireless link for transmitting patient record archival data to the medical team. During the demonstration, stored patient data (including heart rate, temperature, and blood pressure) was transmitted wirelessly from the IDACS to the large screen monitor.

3. Developing a brass-board mock-up (non-functioning) body-worn Surgeon Interface Unit (SIU) that included such commercial components as a stereo see-through visor display, stereo audio, speaker-independent voice recognition, wireless voice / video receiver, and wireless data transceiver. During the demonstration, all components of the mock-up hardware were displayed.

4. Developing a brass-board mock-up central command-and-control system which interprets a limited set of commands in managing the surgical environment through wireless command and control of cameras and patient data display. During the demo, this hands-free command-and-control capability was demonstrated in re-positioning the video camera above the Smart Surgical System surgical table and in calling up archived patient data for display on IDACS monitors.

5. Developing software to filter and interpret acoustic signals from the Smart Surgical System to provide the current heart rate and associated waveform on IDACS monitors. During the demonstration, this capability was demonstrated using a hand-held acoustic sensor.

In addition, progress was demonstrated on the other two components of the OEF as well, albeit limited, given the emphasis on IDACS. For the Smart Surgical System, a conformal antenna was used to wirelessly transmit the signal from the acoustic monitor embedded in the composite surgical table, the latter having been formed via a resin transfer molding process. For the Intelligent Virtual Patient Environment (IVPE), cognitive abilities associated with endoscopic surgery were identified, as were initial voice-recognition and anesthesia requirements, and a front-end requirements generation and analysis "decision support system" software tool was developed (essentially a high fidelity, qualitative and quantitative relational database).

REFERENCES

ARPA Solicitation BAA94-14, 27 January 1994.

"Operating Environment of the Future", Northrop Grumman Proposal X700-94-046A, 29 March 1994.

"Operating Environment of the Future", Northrop Grumman Revised Proposal X700-94-295, 22 December 1994.

"Operating Environment of the Future" DARPA Cooperative Agreement DAMD17-95-2-5022, 22 September 1995.

"Operating Environment of the Future: Interim Progress Report", Northrop Grumman Corporation Letter N560-96-329, 28 October 1996.

APPENDICES

Bibliography of Meetings

Medicine Meets Virtual Reality 4
DARPA Advanced Biomedical Technology Workshop
January 1996

Biosphere 2
DARPA Advanced Biomedical Technology Conference
June 1996

Personnel

Contractor personnel funded by the OEF Cooperative Agreement included:

David D. Hood
Lead Project Manager
New Product Development

Matthew E. Hanson
Project Investigator
Integrated Medical Systems

Richard Bongiovanni
Lead Research Engineer
Smart Surgical System

Bettina Babbitt
Lead Research Engineer
Intelligent Virtual Patient Environment

Mark Berry
Lead Research Engineer
Intuitive Display and Command System